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Modeling the Resilience of Houston's Wastewater System Under Wet Weather Conditions

What are the Issues?

- In 2017 Hurricane Harvey hit Texas causing massive damages resulting in wastewater treatment plants (WWTP) being unable to preform vital removal processes efficiently. Figure 1 shows the operation status of WWTPs during Harvey.
- Aging infrastructure and severe weather due to a changing climate will lead to an increase in failure of vital wastewater treatment processes.
- This research will present a foundation wherein resilience analysis can be preformed for various technological implementations to evaluate improved resilience.
- **Quantitative analysis of improved resiliency enabled by these technologies is not well understood.**

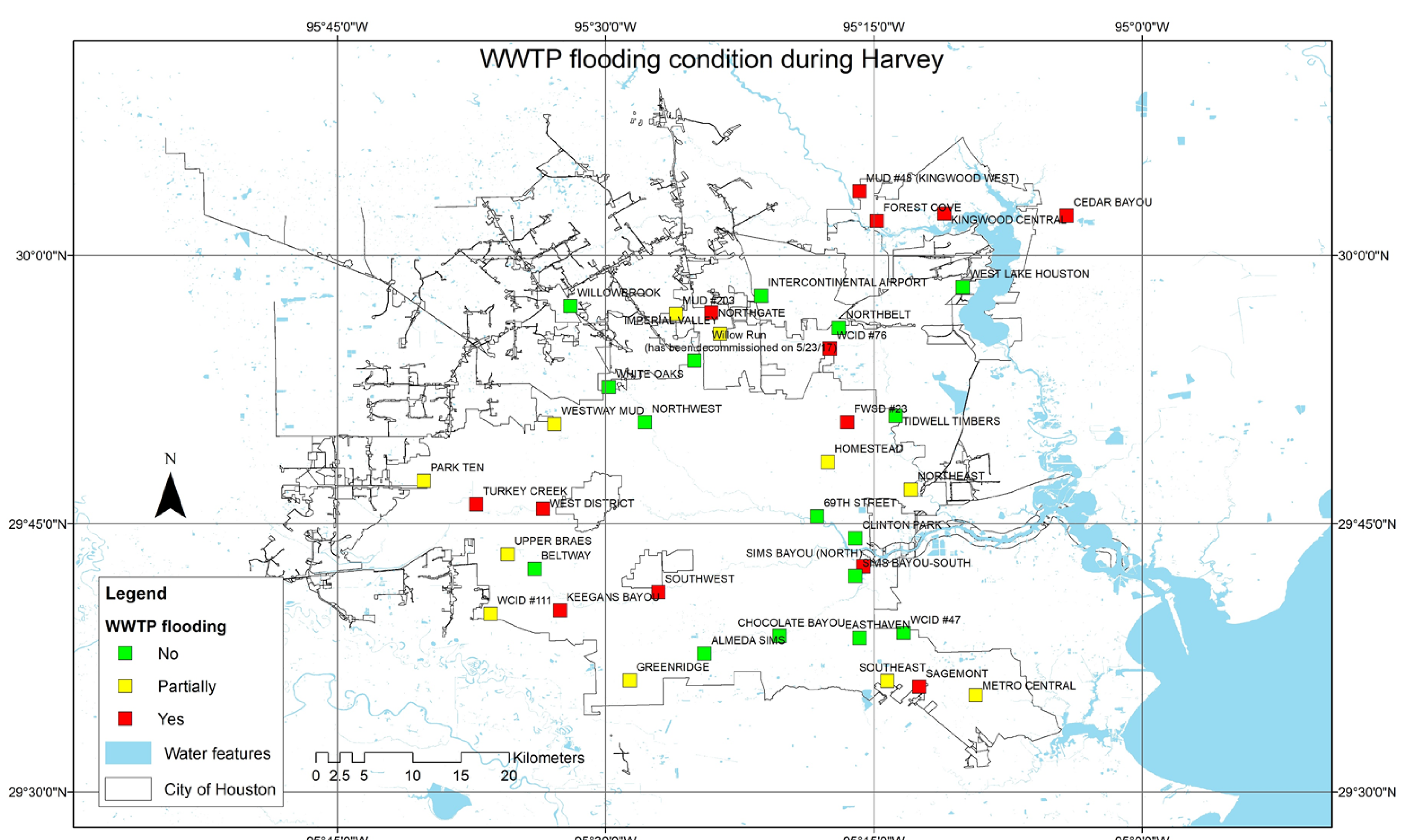

Figure 1: City of Houston WWTP operation status during hurricane Harvey

Overarching Objective

Conduct **resilience assessments** for the Northeast wastewater treatment plant in the City of Houston under different severities of **wet weather** with a **modeling** approach.

This poster will present preliminary modeling investigation using a phenomenological influent generator (BSM) for the Northeast WWTP in Houston

Method

Simulate wet weather flows and constituent concentrations for the Northeast WWTP by using the **Benchmark Simulation Model** (BSM) driven by various treatment technologies and rainfall forcing

- The BSM model assumed *activated sludge* treatment processes.

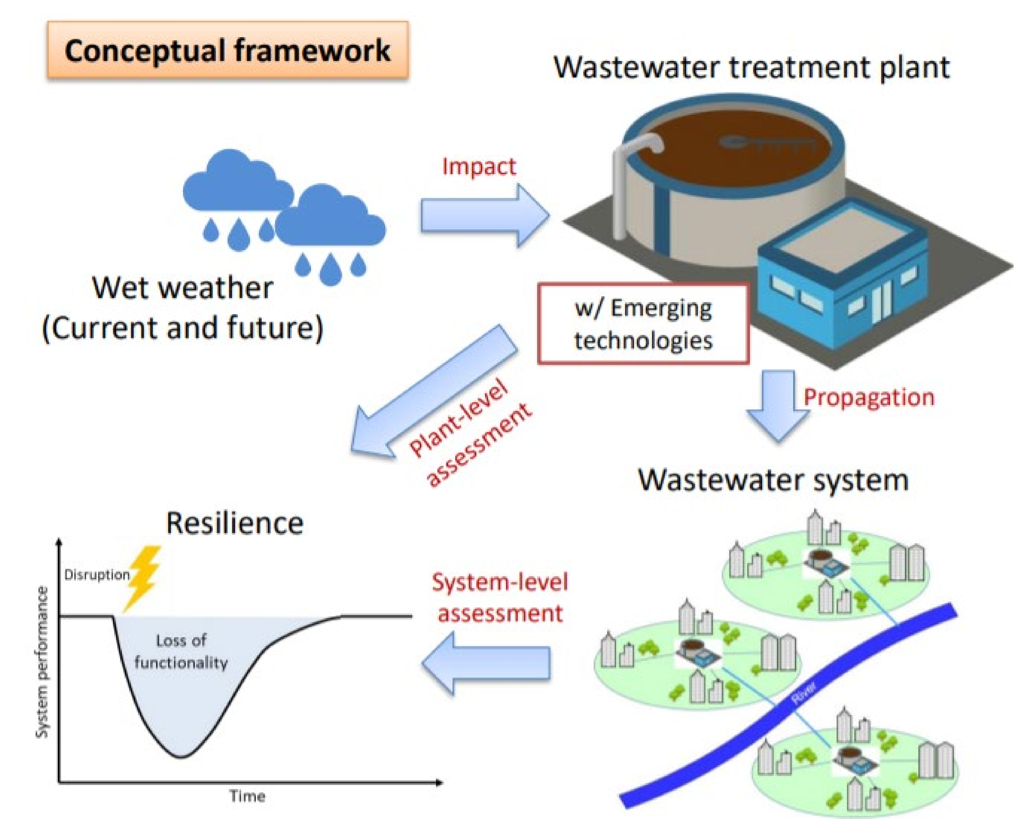

Figure 2: Schematic diagram of the research approach

Detailed steps:

- **Calibrate BSM** to simulate constituent loads that match the NE WWTP in Houston as seen in Figure 3 with observed rainfall data.
  - **Post process model outputs** including inflows, outflows, concentrations of constituents (ammonia).
- **Design various scenarios** using synthetic rainfall intensity (10-, 25-, 50-, 100-year storm events)
- **Evaluate the resilience** of the system performance under the designed scenarios and compare performance
  - Resilience is measured by constituent removal efficiency and time of recovery from disruption.

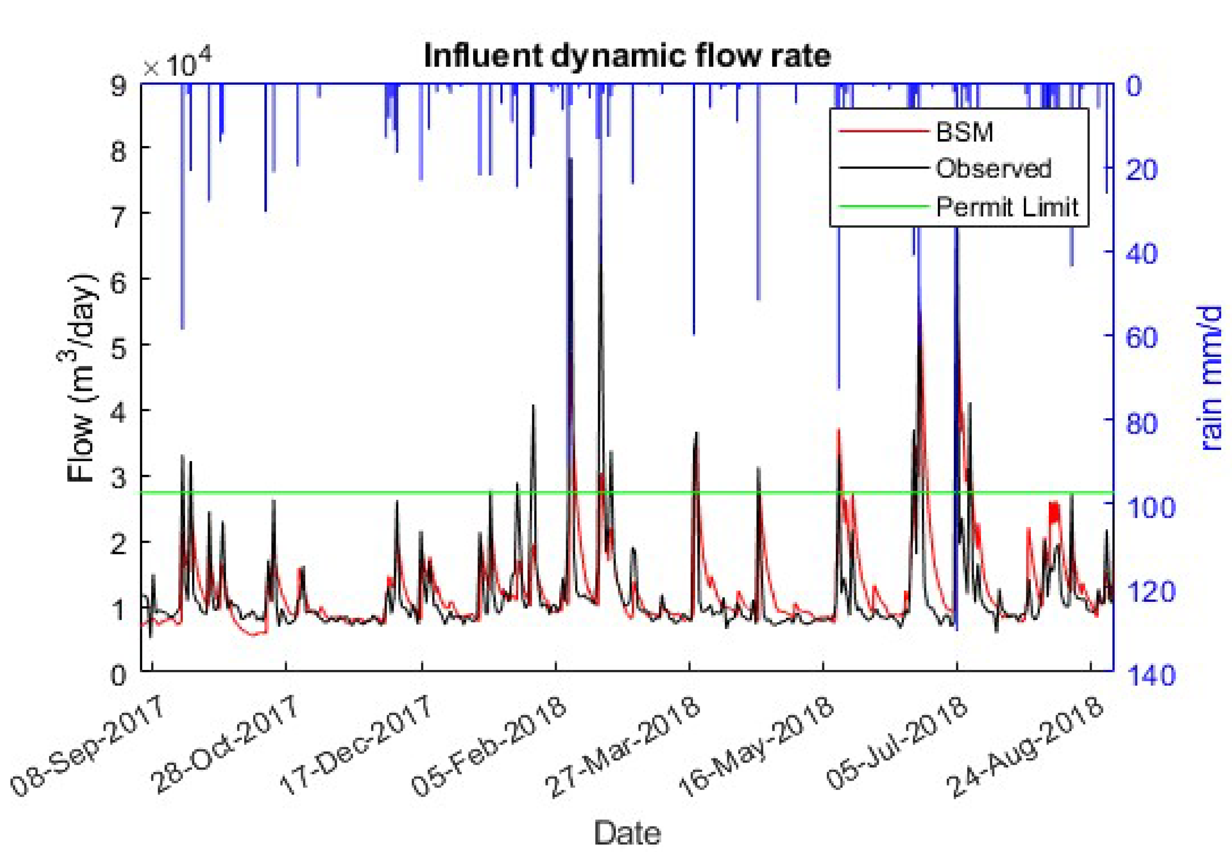

Figure 3: BSM dynamic influent flow rate

Progress

- We are in the process of calibrating the BSM to match the NE WWTP as seen in Figures 3 and 4.
  - We have matched the **flow rate** and the **influent ammonia concentration**
  - We are currently working on calibrating **effluent constituent loads.**

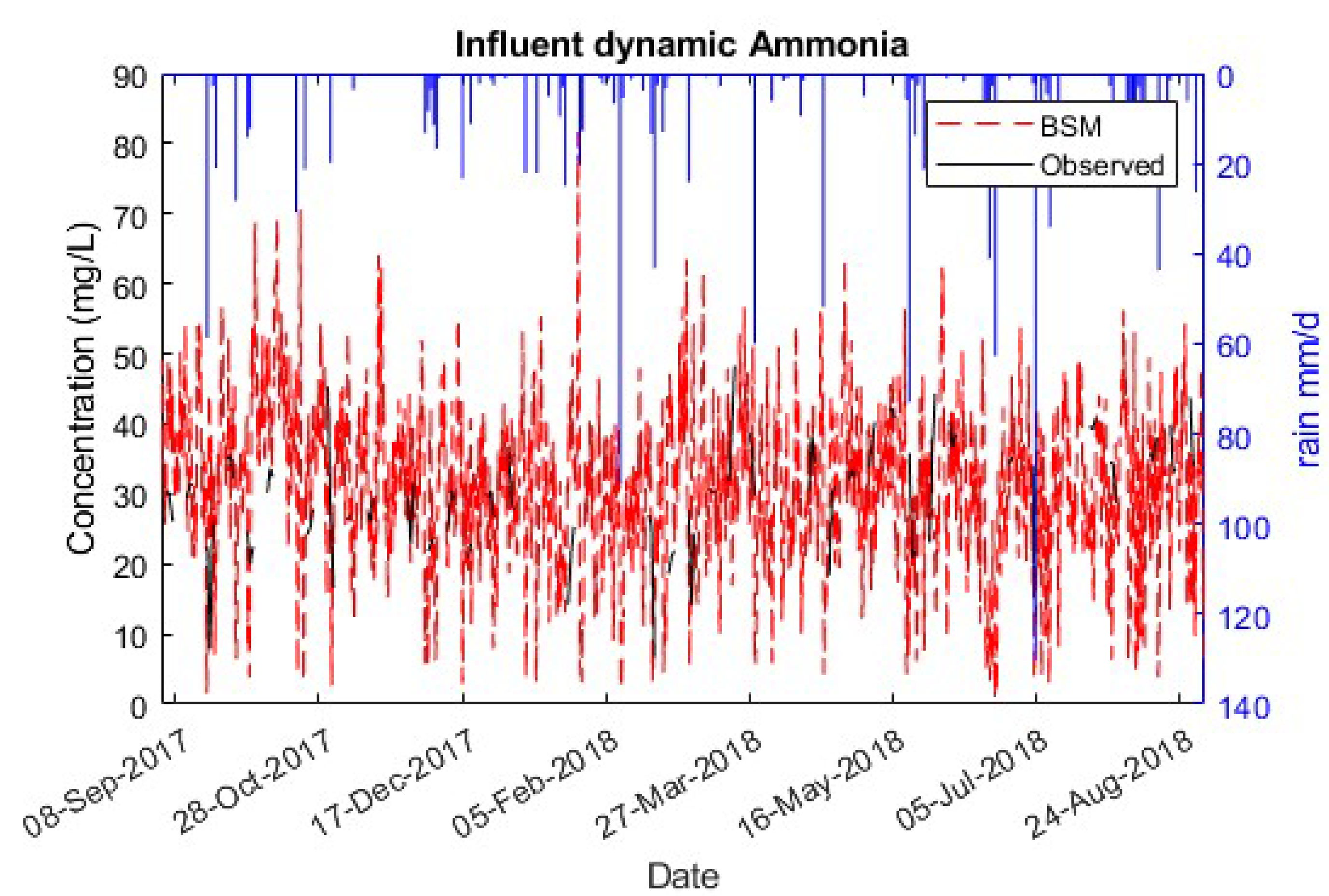

Figure 4: BSM influent Ammonia calibration

Expected Outcomes

- **Longer time of recovery and increased performance reduction** at higher rainfall intensity.
- A **decrease** in resilience.
- Wet weather has an affect on WWTP's more complex than simple dilution.

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